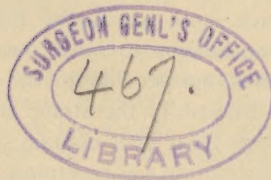


WEBSTER (C.L.)

A description of the Rockford  
shales of Iowa



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## A DESCRIPTION OF THE ROCKFORD SHALES OF IOWA.

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*(Read before the Academy, April 29, 1887.)*

OF the Devonian rocks of Iowa—and I might, perhaps, venture to say, the United States—there is no division more interesting to the paleontologist than the Rockford shales. The great variety and beautiful preservation of the fossil species contained in them, throw much light upon the history of the latter part of the Devonian age, in the northern part of Iowa.

It is a significant fact that many of the fossil species contained in the shales approach more nearly the European forms than do the forms from the same horizon in other portions of America. Some of the species, however, are peculiar to the shales, not being found, so far as is at present known, in the strata of any other portion of the world; and the fact that these beds contain some species whose extreme western limit of distribution was heretofore believed to be hundreds of miles to the east, contributes to their interest.

In this paper I have given, for the most part, only a general description of the strata which underlie the shales, in order that their relation to the shales may be understood.

The area of the shales is represented on the accompanying map. Whether they extend north of the limit indicated on the map, I am unable to say, as the surface is here everywhere so deeply covered by the drift that no exposure of the underlying strata is to be observed; and during the Quaternary period, they were considerably acted upon by the moving ice—so much so, indeed, that over limited areas they were removed nearly or quite down to the underlying strata. The accompanying map shows also the distribution of organic remains in the Devonian rocks underlying the shales.

The lithological characters, as well as the thickness of this formation, are somewhat varied in different portions of its area.

At Rockford and Hackberry, it attains a thickness of from twenty-five to forty-five feet, and is made up of thin-bedded, friable, very argillaceous limestones, varying in color from a light buff to a dark brown, which disintegrate very readily, forming a hard, dark yellow or buff-



colored clay, which, at Hackberry, contains numerous hard, dark red, ferruginous concretions, varying in diameter from one to four inches. The lowest twenty-five feet of the forty-five foot stratum at Hackberry is blue clay, which is mostly covered by a layer of shales.

On Flood Creek, at Rudd, in Floyd County, the shales are well exposed for a short distance in the east bank. Here the following section was taken:

1. Drift and detritus ..... 2 feet.
  2. Yellowish brown (sometimes shaly), thin-bedded limestone, containing several species of corals, *Stromatopora*, *Spirifera*, etc., which are not known to occur in the shales at any other place, but which are more or less common in the limestone in other portions of the State. .... 4 feet.
  3. Yellowish brown, argillaceous, shaly limestone, containing some sand, and numerous species of fossils, as *P. woodmani*, *O. iowensis*, *Luxonema*, *A. reticularis*, etc., and weathering to a yellow clay. This division passes imperceptibly into No. 2. .... 5 feet.
  4. Grayish-buff limestone, made up almost entirely of concretions of a harder and darker material, and containing numerous *Lamellibranchiata* (none of which are known to occur in the shales), with a few specimens of *P. woodmani* and *O. iowensis* at the top, to the bed of the creek. .... 9½ feet.
- Total. .... 20½ feet.

In the bed of the creek, about one-half mile below the above locality, a small quarry has been opened in limestone immediately below number 4. Here measurements gave the following results:

1. Yellowish-buff, thin-bedded limestone. .... 3 feet.
2. Thicker bedded, grayish-blue limestone. .... 3 "

Both divisions contain the same assemblage of fossils, most of which are *Brachiopoda*. Only one or two of the species occurring in these beds are known to extend upward into the higher beds.

In the west bank of this creek, three miles south of the above locality, the shales are again observed. The beds here attain a thickness, by estimate, of about nine feet, and are made up of thin-bedded, somewhat friable, brownish-yellow, calcareous and argillaceous limestones, which contain an abundance of *Fistulipora occidens* (?).

Underlying the shales is a nine-foot stratum (not well exposed) of limestone, which is apparently the equivalent of the concretionary limestone of the Rudd section.

In the extreme south-western part of Floyd County, and the south-eastern portion of Cerro Gordo County, the shales are much thinner,

and are less argillaceous than those portions of the beds which are exposed at Rockford and Hackberry. The fossils in this region are very abundant and finely preserved. The species *Naticopsis gigantea* attains a somewhat larger size and is more abundant than in some other portions of these beds.

On a small creek, at Owen's Grove, in Cerro Gordo County, the annexed section was taken :

|                                                                                                                   |           |
|-------------------------------------------------------------------------------------------------------------------|-----------|
| 1. Drift and detritus (sloping surface, probably concealing<br>several feet of shaly limestone), by estimate..... | 17 feet.  |
| 2. Soft, dark buff, somewhat argillaceous shaly limestone. 7                                                      | "         |
| 3. Blue shaly limestone, containing concretions.....                                                              | 2½ "      |
| Total.....                                                                                                        | 26½ feet. |

About one-eighth of a mile south-west from this locality, on the same creek, is another limited exposure of the shales, which differ in some particulars from those exposed at any other locality, in that they weather to a rather soft, yellowish-white clay, and contain numerous *Lamellibranchiata* and *Gasteropoda* not known to occur in other portions of the beds.

Six miles east of Clear Lake, the shales are seen to outcrop on Willow Creek. They are here somewhat thicker bedded than usual, and vary from a dark buff to a dark brown color; they vary, also, from their equivalents previously described, at other localities, in being slightly sandy. The fossils are not numerous, and nearly all occur in the form of casts.

Two miles east of Clear Lake, the shales are observed as an outlier in a gently undulating prairie region, and present the same paleontological and lithological character (except that they are somewhat more friable) as at the exposure on Willow Creek.

Three miles west of Mason City, in the west bank of Willow Creek, the shales are again finely exposed, and at this locality the following measurements, by estimate, were taken :

|                                                                                                                                       |          |
|---------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1. Drift .....                                                                                                                        | 1 foot.  |
| 2. Thin bedded, shaly, argillaceous limestone, containing<br>some sand and casts of fossils, decomposing readily on<br>exposure ..... | 20 feet. |
| 3. Hard, stiff blue clay, containing numerous concretions of<br>harder material .....                                                 | 12 "     |
| Total.....                                                                                                                            | 33 feet. |

The fossils contained in the shales at this place are comparatively rare, and occur only in the form of poorly preserved casts.



Over this portion of the area occupied by the shales, the deposition seems to have been more rapid than at other localities, and less well adapted to the preservation of the forms imbedded in it; and, inferring from the rarity of even the casts, the conditions would seem to have been less favorable to the existence of life.

The blue clay at this locality, as will be observed, occupies the same position relative to the shales as the blue clay at Rockford, hereafter to be spoken of.

The condition and thickness of the shales in Worth County is difficult, if not impossible, to determine, owing to the unusual depth of the drift deposit which everywhere occupies the surface. It has been reported to me, however, from an apparently reliable source, that the shales are well exposed at a locality some miles south-west from Northwood, in Worth County. I have not personally visited this locality.

That the relation of the shales and their contained fauna to the subjacent strata and its fauna may be better understood, I here give a general outline of that portion of the underlying beds which are included within the area mapped. The shales everywhere occupy the higher position, being overlaid by no rocks older than the Cretaceous.

The following section, taken at Rockford (in part compiled from Hall's Geological Survey of Iowa, Vol. I., Part I., page 309), will show the relation which these beds sustain to the underlying strata at this place:

|                                                                                                                                                                                                                                                |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 1. Drift, etc. ....                                                                                                                                                                                                                            | 5 feet.       |
| 2. Decomposing argillaceous shaly limestone, containing an abundance of beautifully preserved fossils. ....                                                                                                                                    | 25 "          |
| 3. Stiff dark blue clay, devoid of fossils. ....                                                                                                                                                                                               | 20 "          |
| 4. A gently inclined surface, mostly unexposed, with buff and white striped shaly limestone at base. ....                                                                                                                                      | 43 ft. 10 in. |
| 5. Unexposed. ....                                                                                                                                                                                                                             | 2 feet.       |
| 6. Dark colored hard limestone. ....                                                                                                                                                                                                           | 2 "           |
| 7. White pure limestone, with shaly structure (usually very fine grained and brittle, and in places made up almost entirely of <i>Stromatopora</i> ). ....                                                                                     | 5 ft. 6 in.   |
| 8. Hard buff calcareo-silicious sandstone, containing an abundance of <i>Streptorhynchus chemungensis</i> and <i>Spirifera disjuncta</i> , which occur in the form of casts, and all lying with a particular portion of the shell upward. .... | 3 feet.       |
| 9. Rather soft ash-colored calcareo-silicious sandstone, containing casts of fossils*. ....                                                                                                                                                    | 2 "           |
| 10. Somewhat arenaceous thin-bedded limestone. ....                                                                                                                                                                                            | 3 "           |
| 11. Beds not exposed down to the level of Lime Creek. .                                                                                                                                                                                        | 3 "           |
| Entire elevation. ....                                                                                                                                                                                                                         | 114 ft. 4 in. |

\* Three miles south of Rockford, the beds Nos. 8 and 9 are seen to outcrop in the north bank.

At Marble Rock, the limestone beneath the shales is well exposed in the bank of the Shell Rock, with a thickness of ten to fifteen feet or more, and is, for the most part, a rather thick-bedded, hard and fine-grained brittle limestone, varying from nearly white to dark brown in color, with scarcely a trace of fossils.

The rocks which underlie the shales adjacent to Rudd are thin-bedded, fine-grained and brittle limestones, varying in color from nearly white to dark gray, and almost devoid of organic remains.

About one mile below Charles City, in the eastern part of the county, the beds below the shales are well exposed at the "Marble Quarries" in the east bank of the Cedar River. The banks here rise to a height of about forty or fifty feet above the water in the river. The upper five or six feet is made up of rather thin-bedded, compact (sometimes brittle and crystalline) yellowish-gray limestone. The remaining portion of the outcrop is composed of hard, thicker-bedded, yellow or grayish-brown limestone (and sun-cracked shales), which is literally crowded with *Stromatopora*, and a few species of the more common *Brachiopoda*.\* At this locality is quarried the rock from which the "Charles City Marble" is manufactured; the rock, as well as the masses of *Stromatopora*, taking a fine polish.

On the west side of the river, one mile above Charles City, there is an exposure of about ten feet of very hard, fine-grained and brittle limestone, with a more or less perfect conchoidal fracture. The layers vary in thickness from five to thirteen inches, and resemble each other so closely that they can hardly be distinguished in hand specimens, especially as all are unfossiliferous.

At numerous localities along the Cedar, for a distance of sixteen miles above Charles City, the limestone is well exposed, but as it approaches so nearly, in lithological characters and absence of fossils, that of the last section, detailed description is unnecessary.†

On the Cedar River in Mitchell County, the rocks beneath the shales are well exposed about one and a half miles west of Osage, the exposures ranging from forty to more than one hundred feet. The layers

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of Beaver Creek, and, so far as could be observed, reach a thickness of only one or two feet. At Nora Springs, nine miles above Rockford, the same rock is seen to have a thickness of about seven feet; while two and one-half miles south, at the "Old Rowley Quarry," in the east bank of the Shell Rock, it attains a thickness of upward of eighteen feet. At these localities were collected *S. disjuncta*, *S. chemungensis*, *O. iowensis*, *A. hystrix*, *A. reticularis*, *S. demissa*, *Strobilocystites calvini*, etc.

\* As will be seen by referring to the map, this is one of the few localities where fossil remains, in any considerable numbers, are found in the rocks underlying the shales.

† These rocks differ from those described in the last section only in being more or less crystalline.



are of very various lithological characters, varying from yellowish-white and often very heavy-bedded limestone, to dark, grayish-brown crystalline dolomite, with but very few and poorly preserved fossils.

In the north-eastern portion of Worth County, on Deer Creek, near Carpenter, the limestone exposed is rather unevenly bedded and slightly friable, varying in color from yellowish-white to dark grayish-brown, and, so far as observed, devoid of fossil remains.

In lithological character, the rocks outcropping along Rock Creek, in the south-western portion of Mitchell County, are very much like those observed at the locality one mile above Charles City, in Floyd County. The beds, however, are much thicker, and contain an abundance of fossils, represented by the genera *Stromatopora*, *Cyathophyllum*, *Favosites*, and a few of the more common *Brachiopoda*.\*

On the Shell Rock, at Nora Springs, in Floyd County, there is an exposure of over forty feet of limestone, the beds of which vary somewhat in lithological character, but are, for the most part, fine-grained, compact, and more or less brittle limestone (some portions slightly magnesian), crowded with fossils, among which the genera *Favosites*, *Gyroceras*, *Paracyclas*, *Pachyphyllum*, *Stromatopora*, *Alveolites*, *Fenestella*, *Diphyphyllum*, *Atrypa*, and crinoid remains (representing two or three genera) were observed.†

At Rock Falls, in the north-eastern part of Cerro Gordo County, four miles above Nora Springs, the beds below the shales are well exposed. They consist of thin-bedded, hard, and rather crystalline magnesian limestone, varying in color from light gray to nearly black. The most careful search failed to reveal the presence of fossils. The lithological character of the rocks at this place is peculiar, and nothing exactly like it has been observed in any other part of the State. They are all highly magnesian, but not pure dolomites, as they contain rather more lime than belongs to the composition of the double carbonate of lime and magnesia.‡

The following section will give an idea of the general lithological character of the rocks underlying the shales in the region of Mason City, in Cerro Gordo County. It was measured on Lime Creek, three-fourths of a mile above Mason City:

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\* By referring to the map, this will be seen to be the second locality where organic remains are common in the rocks below the shales.

† Most of the species found here are restricted, in their vertical range, to the lower portion of the exposure; while about fifty per cent of the forms do not, so far as is now known, occur in the shales above.

‡ Hall's Geological Survey of Iowa, Vol. I., Part I., page 310.

1. Rather hard, unevenly-bedded limestone, containing  
*Stromatopora* and *Favosites*..... 4 feet.
  2. Grayish or dove-colored fine-grained and somewhat  
brittle limestone..... 16 "
  3. Granular limestone, somewhat magnesian..... 3 "
  4. Uniformly bedded magnesian limestone..... 8 "
- Total..... 31 feet.

In no other portion of Iowa is the superficial covering of the rocks thinner than over a large portion of the area occupied by the four counties mapped. Not only are the rocks well exposed on most of the streams which traverse the region, but limited exposures are numerous adjacent to them, especially in Floyd County. For this reason, the underlying rocky strata can be studied with facility.

It may not be out of place here to give a short description of the only rock which overlies the shales at any place, so far as observed.

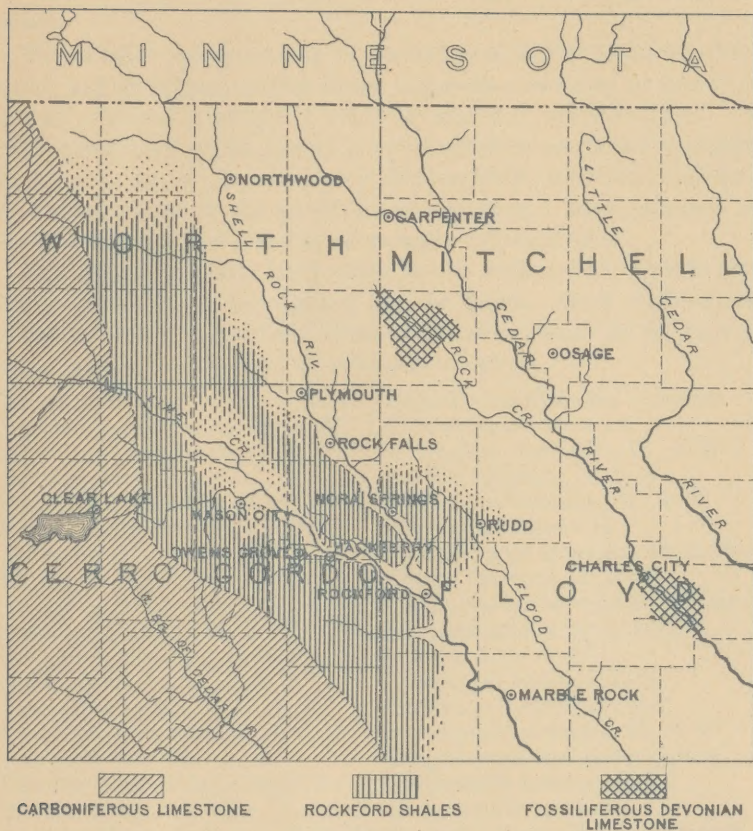
On Section 6, in Township 94 N., 18 W., Floyd County, there is an exposure of coarse-grained sandstone, forming, for a short distance, the north margin of a rather deep trough-shaped depression in the Devonian strata. This outlier is a very coarse-grained, friable, silicious sandstone, interstratified with fine, angular gravel (the angles being more or less rounded), while some of the beds exhibit beautiful examples of ripple-marks.\* This rock varies in color from grayish-white to very dark yellowish-brown, and in some places is capped by-vesicular conglomerate. The bed, so far as could be made out, attains a thickness of from thirty to seventy feet, the upper portion of which is thin-bedded and very much disturbed and broken up, being tilted at almost every conceivable angle, and overlaid at one place by a grayish-white limestone. The lower portion of the stratum is heavy-bedded, and dips at an angle of about twenty-two degrees, in a direction a little west of north.

The section shown by Figure 2, across this depression or valley from north to south, will show the position which the sandstone occupies in relation to the depression and the Devonian strata, the thin-bedded horizontal rock representing the Rockford shales, and the heavier strata beneath representing the subjacent limestones. The trough-like depression, which is in part bordered by this outlier, has an easterly trend, and finally unites with the valley of the Shell Rock. Its average width is about three-fourths of a mile, and its depth from forty to

---

\* This rock is rather peculiar, and nothing exactly like it has been observed in other portions of the State. I have referred it to the Cretaceous, with some doubt as to its true age, since it is quite unfossiliferous.





GEOLOGICAL MAP OF FLOYD, WORTH, MITCHELL AND CERRO-GORDO COUNTIES, IOWA; SHOWING DISTRIBUTION OF THE ROCKFORD SHALES AND ORGANIC REMAINS

Figure 1.

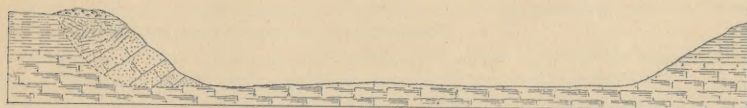


Figure 2.





seventy feet. It is believed that this depression was at one time entirely filled by this sandstone, and subsequently eroded by the action of the ice and the waters derived from the melting of it, during the glacial period.

That a better understanding of the richness of the Rockford shale fauna and its relation to that of the subjacent strata may be gained, I append a partial catalogue of the forms known to occur in them.\* A large percentage of the species enumerated have not been catalogued by previous writers; but my own collection, made personally, embraces all but one or two of the species listed, and these I have examined in the cabinets of others who have personally collected them.

The species followed by † occur in the rocks which underlie the shales, but do not extend upward into the shales. Some of those followed by ? are undescribed forms, while others occur in the form of casts, making their specific identification uncertain.

|                                   |                                     |
|-----------------------------------|-------------------------------------|
| Stromatopora incrustans, H. & W.  | Spirorbis omphalodes, Goldfuss.     |
| Stromatopora expansa, H. & W.     | Pleurotomaria ———?                  |
| Stromatopora solidula, H. & W.    | Acervularia inequalis, H. & W.      |
| Ambonychia ———†?                  | Smithia johanna, H. & W.            |
| Caunopora planulata, H. & W.      | Smithia multiradiata, H. & W.       |
| Rhynchonella venustula,† Hall.    | Callonema lichas? H.                |
| Tellinomya ———?                   | Stromatopora alternata, H. & W.     |
| Fistulipora occidentis, H. & W.   | Crania famelica, H. & W.            |
| Alveolites rockfordensis, H. & W. | Pachyphyllum woodmani, White. §     |
| Aulopora iowensis, H. & W.        | Strophodonta arcuata, Hall.         |
| Cladopora robusta,‡ Rom.          | Gyroceras ———†?                     |
| Aulopora saxivada, H. & W.        | Orthoceras vastator, Hall.          |
| Zaphrentis solida, H. & W.        | Orthoceras procerus, Hall.          |
| Campophyllum nanum, H. & W.       | Strophodonta canace, H. & W.        |
| Aulopora ———?                     | Strophodonta variabilis, Calvin.    |
| Cypricardinia sublamellosa? H.    | Cryptonella eudora, Hall.           |
| Stromatopora ———?                 | Dictyonema ———?                     |
| Chonophyllum ellipticum, H. & W.  | Strobilocystites calvini,† White. ¶ |
| Cystiphyllum mundulum, H. & W.    | Spirifera ziczac,† Hall.            |
| Chonophyllum ———?                 | Strophonella reversa, Hall.         |
| Spirorbis arkonensis, Nich.       | Fenestella ———?                     |

\* Aside from the species herein listed, we have in our cabinet over *eighty* additional forms from the shales, most of which are undescribed.

‡ The individuals of this species are exceedingly rare in the shales, and constitute the only representatives of the genus *Cladopora* yet obtained here.

§ This species is not very abundant in the shales, and is somewhat limited in its geographical range. It sometimes occurs in the limestone immediately underlying the shales.

¶ This species was collected by me from the sandstone which underlies the shales, at Nora Springs. It differs from the forms of this species collected at Iowa City, Iowa, mainly in being somewhat larger. It is of much interest to note the wide distribution of this rare species in the Devonian rocks of this State.

|                                            |                                      |
|--------------------------------------------|--------------------------------------|
| <i>Streptorhynchus chemungensis</i> , Con. | <i>Leiorhynchus</i> ———?             |
| <i>Orthis impressa</i> , Hall.             | <i>Leiorhynchus iris</i> , Hall.     |
| <i>Productella truncata</i> , Hall.        | <i>Ambocælia umbonata</i> , Con.‡    |
| <i>Spirifera whitneyi</i> , Hall.          | <i>Gypidula occidentalis</i> , Hall. |
| <i>Spirifera hungerfordi</i> , Hall.       | <i>Paracyclas</i> ———†?              |
| <i>Spirifera orestes</i> , H. & W.         | <i>Euomphalus</i> ———?               |
| <i>Platystoma</i> ———?                     | <i>Loxonema pexatum</i> , Hall.      |
| <i>Tentaculites</i> ———?                   | <i>Orthoceras</i> ———?               |
| <i>Spirifera cyrtiniformis</i> , H. & W.   | <i>Athyris vittata</i> , Hall.§      |
| <i>Spirifera fimbriata</i> , Con.          | <i>Terebratula navicella</i> , Hall. |
| <i>Leperditia</i> ———?                     | <i>Cryptonella calvini</i> , H. & W. |
| <i>Atrypa reticularis</i> , Lin.           | <i>Aviculopecten</i> ———?            |
| <i>Spirifera disjuncta</i> , † Sow.*       | <i>Naticopsis gigantea</i> , H. & W. |
| <i>Orthis</i> ———?                         | <i>Crania</i> ———?                   |
| <i>Atrypa hystrix</i> , Hall.              | <i>Favosites</i> ———?                |
| <i>Stenochisma contractum</i> , var. saxa- | <i>Paracyclas sabini</i> , White.    |
| tile, Hall.                                | <i>Spirifera macbridei</i> , Calvin. |
| <i>Loxonema</i> ———?                       | <i>Platystoma lineata</i> , Con.     |

Plates of Placoderm fishes allied to *Dinichthys*, and the teeth of other species of fishes. There are also the remains of at least ten species of crinoids, many of which are common both to the shales and the underlying limestones.

The view that some of the fossil forms found in the shales were "drifted in," is advanced by some geologists. I can see no good evidence for this hypothesis, however. I do not, at the present moment, recollect of a single species (with the exception of *Atrypa reticularis*, which occurs in the Niagara) occurring in the shales which is represented in any other rocks, either above or below the Devonian. Neither have I observed more than twenty or thirty species (none of the "drifted" ones are included) to occur in the rocks which immediately underlie the shales, that do not also occur in the shales themselves.

The bedding of all the Devonian rocks, in this part of Iowa, including the shales, is nearly or quite horizontal, showing no evidence of disturbance at or subsequent to their formation. Any agency sufficient to transport these forms from a distance, would also seem capable of leaving a record of its action upon the shaly beds which contained them. But if they were "drifted in" by the ordinary action of the sea, it is evident that they would have been too poorly preserved to be identified even as fossils.

\* This species occurs throughout the sandstone at Rockford and Nora Springs, but is not found in any of the rocks which underlie or overlie it.

‡ The discovery of this species in the Rockford shales is of much interest, as I believe its extreme western limit has been heretofore believed to be in the vicinity of Widder, Ontario.

§ This species was not before supposed to occur so far north in the Devonian rocks of Iowa.



It is true that a few of the more common *Brachiopoda* and corals found in these beds were worn and smoothed by attrition before being imbedded; but if those forms (mostly *Lamellibranchiata*) which are supposed to have been transported had been subjected to the same action, all traces of organization would have been obliterated.

Again, there is no evidence that any of these forms were brought in living, as their remains do not occur outside the shales.

It seems, then, that only one inference can be drawn, and that is, that all of the forms found in the shales were indigenous; that all of the individuals lived, died, and became imbedded where they are found to-day.

From the general lithological characters of the shales, it would seem that they originated as a shallow shore deposit formed at about the close of the Devonian age in Iowa. The organic life of the old Devonian sea, in this portion of its area, culminated in these beds, the underlying rocks, for the most part, being singularly devoid of fossil remains.

